Atmos. Chem. Phys. Discuss., 11, C11508–C11512, 2011
www.atmos-chem-phys-discuss.net/11/C11508/2011/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Optical-microphysical properties of Saharan dust aerosols and composition relationship using a multi-wavelength Raman lidar, in situ sensors and modelling: a case study analysis" *by* A. Papayannis et al.

Anonymous Referee #1

Received and published: 7 November 2011

Comments to the ACPD paper of Papayannis et al., Optical-microphysical properties of Saharan dust. . .. .

General

The paper contains interesting lidar measurements (optical as well as microphysical properties) of a Saharan dust event, observations are compared with surface observations and atmospheric modelling. The paper is appropriate for ACP.

Minor revision are required.

Details:

p. 25475: Abstracts should also include the major findings (numbers!). How strong was the Saharan dust event? Provide some AOT values, etc.

p. 25475-25746: Introduction: The first paragraph is rather boring, and the second paragraph begins with a questionable statement. How can lidar observations reduce the uncertainty in radiative modelling? May be CALIPSO can do this job, but a ground-based low-density continental lidar network?

Instead: Why not reviewing the existing lidar work with focus on desert dust and mixed dust (Europe, America, Asia), and the potential of lidar in this field and afterwards: what are the gaps, the open questions. . . and how this paper contributes to this field of research.

p. 25478: How large are the uncertainties of the other lidar quantities? Extinction coefficient, lidar ratio, Angstrom values?

p. 25479: Errors are mentioned in the case of MODIS, but not in the case of AERONET!

p. 25482: The unkown shape characteristics and the consequences for inversion retrievals using lidar backsatter coefficents needs to be discussed in more detail. Gasteiger (Tellus 2011, SAMUM) obviously shows that progress is made, but the use of a simplified spheroid model is still combined with large uncertainties. The shape problem is not solved, although the results (presented later on) are reasonable. This was further shown by Gasteiger for volcanic ash also (ACP). So, this remains a basic problem. Should be mentioned.

p. 25483: Furthermore, the basic problem of inversions is the ill-posed situation. Unique (unambiguous) solutions will never be available.

The size distribution (radius? diameter?) is ranging from 0.075 to 20 microns in the case of lidar. What is the size range of inversion in the case of AERONET? Please clarify and mention the range used by AERONET, too.

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Before discussing the results of atmospheric modelling, one should state (again) how complex the aerosol conditions in the Mediterranean are, especially over southern Greece. High pollution (urban haze), marine particles everywhere, sometimes biomass burning events, and Saharan dust. Model results are more or less speculative at such conditions. Should be commented. Modelling is a crucial job in that regions.

p. 25484: Surface measurements in Athens (influenced by sea breeze effects, lofted dust layers, urban haze from surrounding countries) linked to profile observations,. . .. does that make sense?! Can such observations at ground be compared with lidar observations (focus on lofted, widely decoupled dust)? What do you expect from such comparisons? Some critical statements will improve the message of the paper.

Figure 2 presents backward trajectories: Arrival times of 15 and 19 UTC would be more appropriate. To my opinion (when looking at the air mass travel heights) there was always the possibility for mixing of desert dust with marine particles and anthropogenic haze, originating from Africa, Spain, Italy and accumulating over the Mediterranean Sea.

Figure: I see the boundary layer developing in one deep aerosol layer reaching to 3.5-4 km height! That's it. Sure pronounced layers and some layering can be observed, too. But smooth, almost absolutely well mixed layers (indicating considerable aging under undisturbed conditions, no further aerosol sources) can never be observed over Greece (I speculate).

p.25488: What is the typical value for the particle mass concentration in Athens. Should be mentioned.

The optical properties in Figure 5 support my opinion. This is a mixture of dust and haze and. . .?

If I look at the Tesche paper (Tellus 2009) or better Tellus 2011 (SAMUM, Cape Verde), I do not see an agreement with your results. The dust lidar ratio after Tesche seems to

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be close to 55 sr, but over Athens you observe values higher than 70sr. This is what Tesche (SAMUM, see both part I and II) observes when dust is mixed with smoke over Cape Verde. And the Angstrom values are clearly lower than 0.5 for pure dust after Tesche (and also after Gross. 2011). And your values are around 1 (mixture of haze, AE about 2, and dust, AE about 0) and this it, what I expect for lofted layers is this area. So, the lidar results are trustworth, the interpretation could be better.

p. 25490: How do you know these fractions? 15%, 65%, 31-79%? I expected there is always a large contribution of Athen haze. What is the typical haze AOT in Athens? Please mention!

p. 25492: Obviously the discussion comes to the right conclusion: polluted or mixed dust was observed with lidar!

p. 25493: I do not believe in any atmospheric modelling for such a crucial area. Accordance or agreement only means that the model can obviously (re)produce realistic (measured) scenarios.

p. 25495: The conclusions must be be re-phrased. If the Angstrom is higher than 0.5, then the aerosol cannot be pure dust. Pure dust produces 0. to 0.5.

Figure 5: The color plot shows backscatter above 300m. But the optical properties are presented above 1500m. Is there no chance to get some backscatter coefficients in the boundary layer and the entrainment zone so that the potential entrainment of dust into the boundary layer could be studied, or quantified. Figure 5 clearly shows: This is mixed dust, opposed to the pure dust cases found during SAMUM. There should be some error bars at the extinction, backscatter, lidar ratio, and Angstrom values.

Figure 6: I do not see (find) the DREAM values.

Figure 7a is a excellent. But I would plot the AERONET 1330UTC size distribution (at the moment in Fig.7b) in Figure 7a, too, and would then skip 7b.

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Interactive Comment

Interactive comment on Atmos. Chem. Phys. Discuss., 11, 25473, 2011.

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